



TENNESSEE DEPARTMENT OF
EDUCATION
FIRST TO THE TOP

Structural Systems II

Primary Career Cluster:	Architecture & Construction
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6165
Prerequisite(s):	<i>Structural Systems I</i> (6164)
Credit:	1-2 credits (see Recommended Credit below)
Grade Level:	11-12
Graduation Requirements:	This course satisfies one or two of three credits required for an elective focus when taken in conjunction with other Architecture & Construction courses.
Programs of Study and Sequence:	This is the third course in the <i>Structural Systems</i> program of study.
Aligned Student Organization(s):	SkillsUSA: http://site1.tnskillsusa.com/ Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit http://tn.gov/education/cte/work_based_learning.shtml .
Available Student Industry Certifications:	Modules may count towards NCCER Carpentry.
Dual Credit or Dual Enrollment Opportunities:	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	522, 575, 580, 592, 706
Required Teacher Certifications/Training:	None
Teacher Resources:	http://www.tn.gov/education/cte/ArchitectureConstruction.shtml

Course Description

Structural Systems II is an advanced-level course that builds on the introductory skills learned in the *Fundamentals of Construction* and *Structural Systems I* courses. This course will explore advanced framing, the physics of structural loads, and the coverings and finishes of structural systems. Upon completion of this course, proficient students will be able to install interior and exterior finishing, including roofing, siding, thermal and moisture protection components, drywall, doors, and trim.

Throughout the course, students will interpret construction drawings to complete projects, implementing material estimating procedures and safe working practices. Standards in this course also expand on principles of the construction industry and delve deeper into business and project management strategies. Students will continue compiling artifacts for inclusion in their portfolios, which they will carry with them throughout the full sequence of courses in this program of study. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, Tennessee Physical Science Standards, Tennessee Physics Standards, and the National Center for Construction Education and Research (NCCER) Curriculum.*

Program of Study Application

This is the third course in the *Structural Systems* program of study. Flexibility is built in to offer this course for either one or two credits, depending on school capacity and teacher background. Whether offered for one or two credits, this course can feed into a fourth-level *Construction Practicum* course in which students can apply the skills learned throughout the program of study toward the completion of an in-depth, semester- or year-long work-based learning (WBL) apprenticeship or internship. For more information on the benefits and requirements of implementing this program in full, please visit the Architecture & Construction website at <http://www.tn.gov/education/cte/ArchitectureConstruction.shtml>.

Recommended Credit

If all standards in this course are covered, the course is recommended for two credits. If only one credit is to be offered, it is recommended that the following standards be covered:

1 Credit Option

Content	Standards
Safety	1, 2, 3
Tools & Equipment	4
Construction Industry Principles	5, 6
Structural Systems Loads	7, 8
Cold-Formed Steel Framing	9, 10
Exterior Finishing	11, 12, 13, 14
Thermal & Moisture Protection	15, 16, 17, 18
Roofing Applications	19, 20
Green Building	33
Construction Drawings & Specifications	34, 35
Business & Project Management	36, 37, 38
Portfolio	39

Course Standards

Safety

- 1) Identify safety hazards on a jobsite and demonstrate practices for safe working. Accurately read, interpret, and demonstrate adherence to safety rules, including but not limited to rules pertaining to electrical safety, Occupational Safety and Health Administration (OSHA) guidelines, and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. Recognize and employ universal construction signs and symbols such as colors, flags, stakes, and hand signals that apply to construction workplace situations. Research and evaluate construction company safety plans from local industry. Explain the need for jobsite security to prevent liability. Drawing from examples, create and implement a jobsite safety program in the class to ensure safe practices and procedures including jobsite security procedures. (TN Reading 3, 4, 6; TN Writing 2, 4)
- 2) Maintain safety records and demonstrate adherence to industry-standard practices regarding general machine safety, tool safety, equipment safety, electrical safety, and fire safety to protect all personnel and equipment. For example, when operating tools and equipment, regularly inspect and carefully employ the appropriate personal protective equipment (PPE), as recommended by Occupational, Safety & Health Administration (OSHA) regulations. Incorporate safety procedures when operating tools and equipment, such as hand and power tools, ladders, scaffolding, and lifting equipment. Complete safety test with 100 percent accuracy. (TN Reading 3, 4)
- 3) Follow procedures to work safely around materials. Adhere to responsibilities for employees in material safety as outlined by the Hazard Communication Standard (HazCom), such as locating and interpreting material safety data sheets (MSDS). For example, obtain an MSDS for a given material from a supplier in the community. Demonstrate safe procedures to move materials by planning the movement, properly lifting, stacking, and storing materials, and selecting proper materials-handling equipment. (TN Reading 3, 4)

Tools & Equipment

- 4) For each of the systems covered in this course, identify and select the proper tools and accessories, critique the readiness of the tools, use the tools to accomplish the desired tasks, and then return the tools and accessories to their proper storage. Research a new technology recently developed for the construction industry. Write persuasively to convince an employer how the use of the technology could benefit the company, citing evidence from resources. For example, describe how a new power tool could improve efficiency and reduce muscle fatigue for a construction team. (TN Reading 1, 2, 3, 4; TN Writing 1, 4, 7, 9)

Construction Industry Principles

- 5) Locate and assess the Tennessee Contractor's Licensing Board's website and analyze the policies and requirements for construction work in Tennessee. Explain how such policies impact local construction businesses. (TN Reading 2, 3, 4)

- 6) Consult a variety of sources to describe alternatives to traditional project delivery methods, such as the design-build and construction management-related methods, distinguishing among the roles and relationships of various construction personnel in each scenario. Examine the project delivery method of an actual company. Develop a company profile with supporting graphics the company could share with a client describing the services provided and explaining the project delivery method used by the company. (TN Reading 2, 3, 4, 5, 7; TN Writing 2, 4, 8)

Structural System Loads

- 7) Categorize and describe the structural loads that act on a building, including vertical loads (such as dead loads, live loads, and rain loads) and lateral loads (such as wind and earthquakes). Drawing on textbooks and other resources, create a visual display with supporting text to explain how the various loads act on a building's structural system. (TN Reading 2, 4, 5, 7; TN Writing 2; TN Physics 1)
- 8) Distinguish among the types of structural failures that can occur in a structural system, including compressive failures, tensile failures, and buckling failures. Explain how specific components of a structural system prevent structural failures based on descriptions in texts and through classroom experiments, synthesizing information gathered from both to illustrate concepts. For example, explain how blocking between studs in a wood frame wall prevents the buckling of studs. (TN Reading 2, 4, 5, 7, 8, 9; TN Writing 2)

Cold-Formed Steel Framing

- 9) Examine the components, fasteners, tools, and procedures used in cold-formed steel framing; compare and contrast cold-formed steel framing with wood framing in building construction. Outline the major similarities and differences in each and write persuasively to provide a recommendation to a client for a specific project. (TN Reading 2, 3, 4; TN Writing 1, 4, 9)
- 10) Demonstrate the ability to build steel frame components including back-to-back, box, and L-headers. Work in teams to lay out and install steel stud walls (both structural and non-structural) with openings to include bracing and blocking by implementing required safety techniques, tools, and equipment. (TN Reading 3; TN Math N-Q)

Exterior Finishing

- 11) Examine a wall section drawing for a specific building. Identify, define, and explain the function of each component including wall insulation, flashing, and the structure of the cornice. Draw from textbooks and other resources to annotate the wall section drawing with notes explaining the purpose of each component. (TN Reading 1, 2, 3, 4, 5, 7; Writing 2, 4, 9)
- 12) Interpret wall section drawings to safely construct a cornice. For example, accurately measure materials, employ tools, and follow procedures to build a box cornice, checking for accuracy in each step. (TN Reading 3; TN Math N-Q)
- 13) Analyze various finish systems used to sheath a building, including but not limited to wood siding, fiber-cement siding, vinyl siding, metal siding, stucco, and masonry veneer finishes.

Perform a case study of three different buildings in the community which are sheathed in different ways, hypothesizing why the different materials and methods were selected for each. (TN Reading 2, 3, 4)

- 14) Estimate the siding materials needed to cover a building utilizing mathematical principles such as area formulas and quantitative reasoning. Utilize the appropriate procedures, tools, and materials to install various types of siding. For example, identify three siding methods that are commonly used in the area and demonstrate the ability to plan the installation of and install each. (TN Reading 3; Math N-Q)

Thermal & Moisture Protection

- 15) Explain the impact of heat transfer in a building, including heat loss during cold temperatures and heat gain during warm temperatures. Describe how building components such as insulation work to resist the transfer of heat in a structure. Interpret charts and graphs in building codes to determine the recommended r-values of insulation in a given location. (TN Reading 2, 4, 5; TN Physical Science 2; TN Physics 2)
- 16) Categorize the various types of insulation based on their characteristics and installation method. Summarize the key properties and installation procedures of each insulation type in a visual display. (TN Reading 2, 3, 4, 7)
- 17) Describe the materials and methods used in a structure for moisture control, waterproofing, and ventilation. In a written narrative, explain how a vapor barrier protects an interior from moisture and describe the permeability rating necessary for a material to be considered a vapor retarder. Write guidelines for a builder or architect to use as reference when selecting appropriate vapor barriers for a specific location based on the climate and other factors, citing evidence from textbooks and other resources. (TN Reading 1, 2, 4; TN Writing 2, 4, 7, 9)
- 18) Interpret construction drawings and building codes to select and estimate the thermal and moisture protection materials needed to complete a project utilizing mathematical principles such as area formulas and quantitative reasoning. Utilize the appropriate procedures, tools, and materials to install blanket insulation in a wall, a vapor barrier on a wall, and building wraps. (TN Reading 2, 3, 4; TN Math N-Q)

Roofing Applications

- 19) Compare and contrast the materials, methods, and procedures for roofing with fiberglass shingles with other roofing materials such as wood shingles, metal roofing, and membrane-type roofing systems. Perform a cost analysis for a client to help the client choose between two roofing materials for a specific project given the site location, project budget, environmental considerations, and other factors. (TN Reading 2, 3, 4; TN Math N-Q)
- 20) Apply the appropriate tools, equipment, and procedures to safely install shingles on a roof including strategies for watertight installation, using quantitative reasoning and geometric formulas where applicable. For example, interpret construction documents to estimate the roofing materials needed to install fiberglass shingles on a gable roof. After preparing the roof

with underlayment, flashing, and other preparation materials, install fiberglass shingles, install a cricket or saddle, and install ridge caps. (TN Reading 3; TN Math N-Q, G-SRT)

Windows, Doors, and Door Hardware

- 21) Describe the common styles and components of windows. Read and interpret construction drawings, window schedules, specifications, and manufacturers' information to determine the types of window and installation procedures required for a project. Apply the appropriate tools, equipment, and procedures to safely install windows. (TN Reading 2, 3, 4)
- 22) Analyze the parts of a door frame, including sills, jambs, and casings, and describe different interior door types. Read and interpret door schedules and other construction documents to determine the type of door and door hardware required for a project. (TN Reading 2, 4)
- 23) Apply the appropriate tools, equipment, and procedures to safely install a door, including checking the plumb and square of a door frame and installing a prehung door unit. Demonstrate proper procedures to work with door hardware, including laying out and cutting hinges in a wooden door and installing door closers and locksets. (TN Reading 3; TN Math N-Q)

Drywall Installation & Finishing

- 24) Describe the various components involved in drywall installation, including the types of drywall, drywall fasteners and adhesives, and drywall accessories. Explain the procedure to install drywall, noting the proper tools involved. Describe the role drywall plays in sound isolation and fireproofing, outlining how fire-rated walls are constructed. (TN Reading 3, 4, 5)
- 25) Read and interpret drawings to select the type and thickness of drywall required for a specific installation. Utilize quantitative reasoning to estimate the amount of drywall, fasteners, and finishing materials needed for a project. (TN Reading 2, 4, 6; TN Math N-Q)
- 26) Install gypsum drywall panels on stud walls and ceilings using different types of fastening systems, including nails, screws, and adhesives. Perform single-layer and multi-layer installations by implementing required safety techniques, tools, and equipment. Describe the differences in procedures for installing gypsum panels on steel wall frames. (TN Reading 2, 3; TN Math N-Q)

Drywall Finishing

- 27) Describe the procedures, tools, and materials used in drywall finishing, indicating the purpose of each material. Read and interpret industry standards regarding drywall finish such as the *Recommended Levels of Gypsum Board Finish*. Observe finished drywall and determine the level of finish, citing evidence from industry standards documents. (TN Reading 1, 2, 3, 4, 6, 7; TN Writing 9)
- 28) Implement the proper procedures, tools, and materials to finish drywall. Procedures include preparing compounds, taping joints, applying joint compounds, sanding, spotting fastener heads, and finishing corners. (TN Reading 3)

- 29) Diagnose the cause and determine the appropriate solution for problems that occur in drywall finishing, citing evidence from textbooks or technical manuals in order to justify why the chosen solution is appropriate. Implement the proper tools and procedures to patch damaged drywall. (TN Reading 1, 2, 3, 4; TN Writing 9)

Window, Door, Floor, and Ceiling Trim

- 30) Distinguish among the different types of standard trim, including base, wall, ceiling, window, and door trim. Utilize the proper tools, equipment, and procedures to make square cuts, miter cuts, and coped joint cuts in trim. (TN Reading 2, 3, 4)
- 31) Apply the appropriate tools, fasteners, and procedures to install window, door, floor, and ceiling trim. Estimate the quantities of different trim materials needed for a given room. (TN Reading 3; TN Math N-Q)

Cabinet Installation

- 32) Identify the components which make up a basic set of cabinets, analyzing the purpose of and interrelationships among each component and explaining the sequence in which each is constructed. Components include wall cabinets, base cabinets, countertops, and cabinet hardware. Read and interpret drawings and technical manuals to determine the steps, equipment, and materials needed to lay out and install a basic set of cabinets. Develop a timeline and action steps needed to complete a cabinet installation. For example, narrate the steps in an explanatory text that a peer could use to install a set of cabinets. (TN Reading 1, 2, 3, 4, 5, 7; TN Writing 2, 4)

Green Building

- 33) Research and identify green strategies used in the design and construction of buildings specifically impacting carpenters. Drawing on resources such as those from the U.S. Green Building Council, discuss green work practices of carpenters, such as reducing waste in the construction process, citing resources to support claims. (TN Reading 1, 2, 4)

Construction Drawings & Specifications

- 34) Explain the relationship between construction drawings and specifications. For example, describe how both the construction drawings and specifications provide information about the exterior sheathing indicated for a building. Examine construction drawings and specifications, to determine the requirements of the sheathing for a given part of a building, and verify with measurements and other sources as needed. (TN Reading 1, 2, 4, 5, 6, 7, 8)
- 35) Describe processes by which construction professionals obtain clarification from architects regarding construction documents, such as by the use of requests for information (RFI's). Write a request for information (RFI), as would a construction professional to an architect to request clarification for a detail of the construction documents, such as the selection of a product. (TN Writing 4)

Business & Project Management

- 36) Establish and implement specific goals to manage project assignments in a timely manner, including organizing teams to effectively manage assignments, monitoring and reporting on project progress, and evaluating a completed project according to client requirements. For example, inspect and critique a team member's work, providing constructive feedback for improvement. Similarly, respond to constructive feedback from a team member to improve project outcomes and meet project goals. (TN Reading 2, 6; TN Writing 2)
- 37) Perform estimating and scheduling techniques for a long-term project, including calculating material quantities and cost (including tax) and labor cost to complete a bid sheet; scheduling construction activities using a flow chart; and determining amounts to be charged to the client at various intervals throughout the project. (TN Reading 3, 7; TN Math N-Q)
- 38) Utilize technology to write and share periodical reports (weekly, monthly, etc.) to provide others with information about progress during construction activities as would a project manager to a supervisor. Summarize activities in a narrative form including overall progress in relationship to a previously planned schedule. (TN Reading 3; TN Writing 2, 4, 6, 10)

Portfolio

- 39) Update materials from coursework to add to the portfolio started in *Fundamentals of Construction* and *Structural Systems I*. Continually reflect on coursework experiences and revise and refine the career plan generated in prior courses, using technology where appropriate. Include photographs or illustrations and written descriptions of sequential progress in construction projects. (TN Writing 2, 4, 5, 6)

Standards Alignment Notes

*References to other standards include:

- TN Reading: [Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects](#); Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
 - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: [Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects](#); Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
 - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 3 at the conclusion of the course.
- TN Math: [Tennessee State Standards for Mathematics; Math Standards for High School: Number and Quantity, Geometry](#) (pages 58-83).
 - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to

collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative and geometric reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.

- TN Physical Science: Tennessee Science: [Physical Science](#) standard 2 may provide additional insight and activities for educators.
- TN Physics: Tennessee Science: [Physics](#) standards 1 and 2 may provide additional insight and activities for educators.
- NCCER Curriculum: [National Center for Construction Education and Research](#)
 - Note: NCCER accreditation is required to offer NCCER credentials to students. Instructors trained through the NCCER Instructor Certification Training Program (ICTP) may use the NCCER curricula to teach the listed standards. By doing so, their students will receive a certificate of completion for NCCER Carpentry Level Two and be placed in NCCER's National Registry Database.
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
 - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.